

defects 4. In the present invention, atoms other than the atoms occupying the 4b sites are filled in the lattice defects.

Please replace the paragraph beginning on page 10, line 7, with the following:

FIG. 4 is a cross sectional view to show an example (layer constitution) of an optical information recording medium according to the present invention. A typical information recording medium is constituted by forming a recording layer 8 having the above-mentioned constitution on a substrate 7 selected from transparent polycarbonate resin, an acrylic resin, a polyolefin-based resin, a glass sheet or the like. Protective layers 9 and 10 can be formed on at least one surface of the recording layer. Reflective layers 11 can be formed on the respective protective layers. Overcoats 12 can be formed on the top layers, or the overcoats can be replaced by protective plates 14 that are adhered by adhesive layers 13. For guiding laser beams used in recording/reproducing, a spiral or concentric circular concave-convex groove track, a pit array, a track address can be formed on the substrate surface. Such a recording medium is irradiated with a laser beam in order to cause reversible phase change in the recording layer between a crystalline phase and an amorphous phase, so that information can be rewritten. In the case of crystallization, the recording medium is irradiated with a laser beam like a pulse in order to keep the irradiated part at or above an interim crystallization change temperature. In changing the recording layer to be amorphous, the layer is irradiated with a more intensive laser beam for a period equal to or shorter when compared to a case of crystallization, so that the irradiated part is melted instantaneously and then quenched. This reversible phase change can be detected as a change in the reflectance or transmittance. This reproduction is carried out by irradiating the recording medium with a laser beam weakened not to provide any additional influence so as to detect changes in the strength of light reflected from the irradiated portion or transmitted.

Please replace the paragraph beginning on page 10, line 33, with the following:

An optical information recording medium according to the present invention, as shown in FIGs. 4A-4J, will be characterized by a composition of a material composing the recording layer 8 and by the internal structure. A representative example will be explained below with reference to a Ge-Sb-Te based material. As reported in N. Yamada et al., J. Appl. Phys. 69(5), 2849 (1991), a Ge-Sb-Te material is crystallized to have a face-centered cubic structure meta-stably by irradiating a laser beam. In addition to that, a recent research presentation by the same author (MRS-Buttletin, 21(9), 48(1996) and a research presentation by Nonaka et al. (papers for the tenth symposium on phase change recording, p.63) suggest that the metastable phase necessarily contains many lattice defects (vacancy). The following description is about a representative composition of a stoichiometric compound composition of $\text{Ge}_2\text{Sb}_2\text{Te}_5$. The material has a metastable phase of rock-salt type (NaCl type). As shown in FIG. 1, all lattice positions (4a sites) corresponding to Cl atoms are occupied by Te atoms 1, and all lattice site positions (4b sites) corresponding to Na atoms are occupied by Ge atoms 2 and Sb atoms 3 at random depending on the composition ratio. However, since the total number of the Ge atoms and the Sb atoms is greater than the number of the Te atoms, the 4b sites necessarily has lattice defects 4 of about 20% (about 10% of the entire sites). The lattice defects also are located at random (An example of atom positions in 4a sites is shown).

Please replace the paragraph beginning on page 13, line 32, with the following:

As a result of various analyses and experiments, the inventors have found that not all elements can fill lattice defects and that an ionic radius is an important factor to determine the conditions. When the 4a sites have lattice defects, the defected lattices of the base materials will be filled easily if R_{im} is sufficiently close to R_{nc} , where R_{nc} denotes an ionic radius of an

element having a minimum ionic radius among elements occupying the 4a sites and Rim denotes an ionic radius of an additional element. According to Third Revision of Manual of Basic Chemistry (Kagaku-binran Kiso-hen) II issued by Maruzen Co., Ltd., the radius of a Ge^{4+} ion is 0.67nm, the radius of a Sb^{5+} ion is 0.74nm, and the radius of a Te^{2-} ion is 2.07nm when the coordination number is 6. For Ge-Sb-Te, an element can enter a lattice easily when it has an ionic radius substantially the same or slightly smaller than the radius of a Ge ion located at a 4b site. Each Ge ion has a smaller ionic radius than that of a Sb ion.

Please replace the paragraph beginning on page 16, line 1, with the following:

Atoms in a rock-salt structure are considered to have a coordination number of 6. Table 1 is a list of ion species each having a coordination number of 6 and ionic radius of about 0.67nm in an order of the ionic radius. Since a Ge^{4+} ion has ionic radius of 0.67nm, ions ranging from a vanadium ion V^{5+} that is about 70% of a Ge^{4+} ion to a Ni^{3+} ion that is about 105% may enter a lattice. That is, effective elements are V, S, Si, P, Be, As, Se, Ge, Mn, Re, Al, Co, Te, Cr, and Ni. Among them, V, S, Si, Mn, Al, Co, Cr, and Ni etc. are suitable. The remaining elements are not suitable, since, for example, Be, As and P may cause problems due to the toxicity, while Ge and Te compose the base material, and Re is a radioactive element.

Please replace the paragraph beginning on page 21, line 28, with the following:

Interface layers 16 and 17 can be formed in an interface between the recording layer and at least one of the protective layers for several purposes, such as preventing atomic diffusion in spacing between the recording layer and the protective layer. Especially, nitrides, nitride-oxides and carbides are suitable for the interface layer. The examples include materials of Ge-N-(O), Al-N-(O), Si-C-N, Si-C or the like, and materials further including Cr, Al or the like, such as Ge-

C-N and Si-Al. Optical absorption A_a of a recording layer in an amorphous state can be decreased relatively with respect to optical absorption A_c of the recording layer in a crystalline state by applying an optical absorption layer 18 over an upper protective layer of the recording layer, or by applying a semitransparent reflecting layer 19 at the light incident side of the recording layer.

Please replace the paragraph beginning on page 25, line 1, with the following:

The increase of the crystallization temperature becomes sharp when the Al concentration is at a level of the sample A5. For this composition, Ddf (concentration of lattice defects) occupies 10% of the whole sites (20% of the 4b sites). For the respective samples, ratios that Al atoms fill lattice defects to Ddf are as follows: A1:0, A2: $0.2 \times Ddf$, A3: $0.5 \times Ddf$, A4: $1.0 \times Ddf$, A5: $1.5 \times Ddf$, A6: $2.0 \times Ddf$, A7: $2.5 \times Ddf$, and A8: $3.0 \times Ddf$. For the samples A5-A8, there are more Al atoms than the lattice defects to be filled. Percentage of the Al atoms to the whole compositions in the respective samples are as follows. A1: 0%, A2: 2.2%, A3: 5.3%, A4: 10%, A5: 14.3%, A6: 18.2%, A7: 21.7%, and A8: 25%.

Please replace the paragraph beginning on page 29, line 27, with the following:

Various additives other than Al were added to $Ge_2Sb_2Te_5$ recording films for the purpose of examining the recording performance of the films. Additives were selected from elements having ion radii similar to an ionic radius of Al, i.e., V, S, Si, P, Se, Ge, Mn, Re, Co, Te, Cr, Ni; elements having melting points similar to that of Al, i.e., Sb, Pu, Mg, Ba; and elements of a separate group, i.e., Ag, Pb, and Sn. Each additive of about 5 atom% was added for examining the effects.